

Teen Birth Rates in the U.S. from 1990 to 2008: The Role of State Policy, Women's Opportunity and Contextual Factors

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Abstract

Objective: Teen birth rates in the U.S. have declined significantly, with the most recent decline spanning two decades; but patterns of teen childbearing differ substantially across states. Although many policy and expenditure decisions are made at the state level, few studies have examined the relationship between state policies intended to reduce teen births or enhance opportunity and the teen birth rate.

Methods: Data from 1989 to 2008 for all 50 states were used in analyses combining time-varying effects models and multilevel modeling, allowing the identification of associations between teen birth rates and state policies that affect women's health and their educational and employment opportunities, as well as other state characteristics that vary over time, while accounting for between-state differences in the teen birth rate.

Results: We find that, at the state level, greater family planning expenditures, higher public assistance benefits, and the proportion of children who are uninsured, are associated with lower teen birth rates and that this relationship has remained constant over the past 18 years. Higher rates of female labor force participation, a lower poverty rate, a higher freshman graduation rate, higher levels of education funding, and a higher proportion of the population with a Bachelor's degree are also associated with lower teen birth rates. Further research on how public assistance policies affect teen childbearing is needed.

Conclusion: This study suggests that state-level efforts to provide reproductive health care and to improve educational and employment prospects for state residents are associated with lower teen birth rates.

Keywords: Teen pregnancy; Adolescent(S); Women's health; State policy; Teen birth rate; Reproductive health; Family planning; Economic opportunity

Introduction

In this study, we assess the degree to which specific policies, expenditures, and social and demographic contextual factors at the state level are associated with teen birth rates in states over time. We examine policies that are directly related to fertility behavior, such as funding for family planning services. We also examine state-level difference in the opportunities that young women experience, such as educational and employment opportunities. While considerable research indicates that young women with better opportunities are more likely to delay motherhood, very little recent research has examined whether state-level context is associated with patterns of teen childbearing.

Births to teenagers have repeatedly been found to be associated with negative outcomes for the mother and child, over and above predisposing background factors [1-3]. Accordingly, many types of interventions have been initiated to reduce the incidence of early childbearing. And the U.S. teen birth rate has been declining since the early 1990s, aside from a slight uptick between 2005 and 2006 [4]. While there is substantial variation across states, between 1991 and 2009, the teen birth rate declined by a third, from 62 to 40 births per 1,000 females ages 15 to 19 [5]. Studies using longitudinal, individual-level, national data suggest that proximal contributors to this decline include a decreased percentage of youth who are sexually active, and increased contraceptive use and decreased sexual risk-taking behaviors among youth who are sexually active [6-11]. Most research seeking to explain the factors that are related to teen birth rates over time rely on individual-level data and numerous evaluations have examined whether specific programs for teens are effective [12]; however, few studies have addressed policy choices that state-level policymakers can enact. These types of studies are important given the potential

role of policies that states can implement to change the behaviors that lead to teen pregnancy, such as increasing access to contraceptives and improving the economic and social opportunities available to women.

On balance, the few studies that have examined state-level data tend to be limited in their scope and methodological approach. For example, most do not adjust for state-level differences, despite evidence that social, demographic, and economic factors related to teen birth rates vary widely among states [13]. A better understanding of the unique contributions of these state-level factors may help inform state and federal efforts to prevent teen pregnancy and reduce teen childbearing. Below, we briefly summarize the research on these factors and identify our hypotheses for expected associations in our analysis.

Policies and Expenditures

Family planning services

Studies of family planning services have predominantly focused on factors associated with access to family planning services (such as Medicaid family planning waivers and the proportion of teens served by family planning clinics) and access to contraception (such

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as laws affecting minors' access to contraceptives). These studies have found that increased access is related to lower teen birth rates [14-17]. Interestingly, one simulation study estimating the effects of expanded access to Medicaid-funded family planning services finds that an additional 5.4 percent of women of childbearing age taking up family planning services would relate to a 1.4 percent reduction in the teen pregnancy rate [18]. To put this finding in context, this equates to a drop from a rate of 50.0 births per 1,000 females to a rate of 49.3 births per 1,000 females. In comparison, only one study examining public expenditures for family planning services was identified, and it finds that the relationship with teen birth rates was not significant [19].

Public assistance

A number of studies examine the relationship between receipt of, and access to, public assistance and teen childbearing. However, only a handful examine this association using state-level data and only one study uses data collected after the Personal Responsibility and Work Opportunity Reconciliation Act of 1996 [15]. These studies have yielded varied findings with no clear conclusion overall [15,20-24]. Fewer studies use state-level data to examine how the specific implementation of the Aid to Families with Dependent Children (AFDC) or Temporary Assistance to Needy Families programs (TANF) – including eligibility and work requirements and family cap policies – is associated with the teen birth rate. Most of these studies find non-significant associations [21,23]. One notable exception is a study that finds that states with “minor parent rules” (policies making a pregnant teen's welfare receipt conditional on living with an adult) have lower teen birth rates than states without such policies [24].

Access to abortion

Findings in the literature are mixed with regard to access to abortion. Policies decreasing access to abortion, such as requiring parental consent, have been related to lower rates of teen pregnancy and teen births in some studies [25], while policies increasing access, such as public funding for abortion, have also been associated with lower rates [16,19]. Other studies find restrictive abortion policies (such as parental involvement laws, waiting periods, mandatory counseling, and parental consent) to have non-significant associations with teen birth or pregnancy rates [15,17,26].

Public education

Our review did not uncover any existing studies examining the association between expenditures on general public education and changes in teen birth rates using data across states and over time. However, cross-sectional analysis suggests that states with higher expenditures per pupil are correlated with lower rates of teen birth and pregnancy [16,27,28].

Social, Economic and Demographic Contextual Factors

Several social, economic, and demographic factors are associated with the influence and/or implementation of policies and also with the teen birth rate. Commonly established factors include income, family structure, and race-ethnicity [17,29,30]. Most studies have been conducted with individual level data, however, some research suggests that a number of factors may be associated with higher state-level teen birth rates. These include the male-to-female ratio [31,32], urbanicity [31,33], unemployment [34,35], low levels of labor force participation [36], low educational attainment [35,37], stronger fundamentalist (traditional) values [16,17], higher levels of violent crime [16] and more frequent non-marital childbearing [4,38]. At least one individual-

level study also finds a relationship between children's access to health insurance and teen births at the individual level, although it has not been studied at the state level [39]. Several studies have linked contextual factors that motivate delayed childbearing to teen and non-marital births. Kearney and Levine [40] find that poor women who lived in areas with greater income inequality were more likely to have a child early and outside of marriage. The qualitative work of Edin and Kefalis [41] suggests that girls growing up in poverty may view motherhood as a positive option when their job and academic prospects are limited. Interestingly, a recent study finds higher viewership of the MTV television show *16 and Pregnant*, as well as higher unemployment, are related to a reduction in the teen birth rate in the viewing area [42]. Cowan [43] finds that teens in states with lower college costs have lower levels of risky behavior, including the number of sexual partners. Similarly, Moore et al. [44], Wilson [45-47] and Small and Newman [48], have theorized that an environment of highly concentrated poverty, low academic achievement, social isolation, few local resources, and limited economic opportunities creates a culture where early non-marital childbearing is more common.

Study Hypotheses

In line with previous individual-level research, we anticipate that greater costs and barriers to pregnancy prevention and higher opportunity cost to women in terms of work, education, and income will be related to a lower teen birth rate. We assess whether similar factors of cost and opportunity at the state-level are related to teen births at the state-level.

Reproductive and health policies and expenditures

First, we hypothesize that increased spending on family planning will relate to lower teen birth rates, assuming that greater spending might provide more access or better outreach. Second, we hypothesize that states with more uninsured children will have higher teen birth rates. It is possible that the increased financial burden of raising children due to low rates of health insurance coverage could deter parenthood among teens. However, we hypothesize that this disincentive would be outweighed by the additional barrier to access to contraception that a lack of health insurance imposes on the youngest adolescents.

Third, we expect a non-significant relationship between AFDC/TANF and Supplemental Nutrition Assistance Program (SNAP) benefit levels and teen birth rate, given that prior research on public assistance and teen birth rates has been mixed and inconclusive. Fourth, we hypothesize that states with more restrictive abortion policies will have higher teen birth rates, and that the relatively limited availability of abortion services to pregnant minors in some states will result in more births. We acknowledge that restricting access to abortion could either drive birth rates up by reducing abortions (thus we would expect to see higher teen birth rates), drive birth rates down by discouraging risky sexual behavior that could lead to an unwanted pregnancy (lowering teen birth rates), or some combination of both (in which case, the magnitude of each effect would determine whether teen birth rates went up or down or remained constant). This analysis cannot determine the mechanism through which abortion laws are related to teen birth rates; nevertheless, we consider abortion policies to be an important contextual factor to control for as we examine the implications of other state-level factors.

Social, economic, and demographic context

Economic theories of rational choice and opportunity cost suggest that poor economic conditions drive teen childbearing, in that teen

girls who find themselves facing few social and economic opportunities see little cost, in terms of lost wages or educational achievement, to early childbearing [40,41,49-52]. Thus, we hypothesize that states with higher female labor force participation rates, lower unemployment rates, and more highly educated populations would have lower teen birth rates. Lacking prior research, we hypothesize that states that spend more on education would have lower teen birth rates, because we expect that teens in those states will have greater access to educational opportunities, which in turn will increase the opportunity costs associated with early childbearing.

We also hypothesize that states with larger fundamentalist populations will have higher teen birth rates, reflecting more traditional family formation patterns with more frequent early parenthood. Finally, we anticipate that lower violent crime rates will be associated with lower teen birth rates, as a reflection of greater social organization and less victimization of the population, including women.

Materials and Methods

Measures

This study examined secondary state-level data compiled from a variety of data sources for all 50 states. All data are from Child Trends' State-Level Database, but original sources used to compile this dataset are described below. We examined a comprehensive set of independent variables, including specific policies and measures of public expenditures, policy-relevant contextual factors, and other social and demographic factors. To the extent possible, data were obtained for all of the years 1989 to 2007, so that the time-varying effects of these variables could be tested. For variables with only a few years of missing data, we imputed values using data from adjacent years. For three variables that were missing considerable data, we use a single year's value for every year in the analysis, thereby treating these variables as fixed in all models (noted below). In other words, we did not test whether their relationship with teen birth rates varied over the 18 years, as the values did not change over time in our analysis.

Dependent variable: The teen birth rate represents the number of live births per 1,000 females aged 15 to 19. State-level data were obtained from the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics' National Vital Statistics System (NVSS). Data for 1990 to 2000 were extracted from CDC's NVSS birth and fertility tables [53]. Rates for 2001 to 2008 were calculated by dividing births by the number of 15-to 19-year-old females (in thousands) from the Census Bureau's intercensal estimates [54], in order to produce rates using the most up-to-date population data, as the rates published by NVSS for these years had not been updated at the time of this analysis.

Reproductive and health policies and expenditures: Public expenditures on family planning services data (in 2006 constant FY dollars) were originally obtained from Sonfeld and Gold [55] for the years 1994, 2001, and 2006, and missing years were interpolated. To estimate the amount spent per female of childbearing age, totals for each state were divided by the number of females aged 15 to 44. Data on current expenditures per pupil in average daily attendance in public elementary and secondary schools (in constant 2006 FY dollars) were obtained from the National Center on Education Statistics' (NCES) Digest of Education Statistics [56]. We constructed a measure of restrictive abortion laws by assigning states a value of "1" if they did not provide public funding for abortions in most or all cases or if they required parental consent or notification for minors to obtain an abortion and a value of "2" if they had both policies in place (and "0"

if they had neither policy). Data were obtained from a policy review periodically issued by NARAL on state laws related to abortion and other reproductive health issues [57]. To measure public assistance benefit levels, we used a measure combining the monthly maximum potential AFDC/TANF benefit for a family of three with Food Stamp/SNAP benefits for a family of three (in 2006 constant FY dollars). These data were obtained from the University of Kentucky Center for Poverty Research [58]. Data on the percent of children ages 6 to 17 who are currently lacking health insurance were obtained from Annie E. Casey's Kids Count Data Center [59].

Measures of social, economic, and demographic context: Female labor force participation rate data (estimated as the percent of the female population ages 15 to 64 who participate in the labor force) were obtained from the Census Bureau [60]. Unemployment rate data were obtained from the Local Area Unemployment Statistics of the Bureau of Labor Statistics [61]. Data on the averaged freshman graduation rate were obtained from the Common Core of Data housed at the NCES [62]. Data on the percent of persons 25 and older with a Bachelor's degree were obtained from the Census Bureau [63]. Because only the years 1990, 2000, and 2006 were available and education levels across this time period appeared to be relatively stable, we used 1990 values in our models and this variable was treated as fixed in all models. Data on the violent crime rate, defined as the total number of violent crimes per 100,000 people, were obtained from the Uniform Crime Reporting Statistics, affiliated with the Federal Bureau of Investigation, U.S. Department of Justice [64].

Data on non-marital childbearing, measured as the percent of all births to unmarried females aged 20 to 24, were obtained from the CDC [53]. State-level data obtained from the Census Bureau were used to calculate the male-to-female ratio [65]. Data on the percent of the population who are members of a "fundamentalist" [66] Christian church (from 1990) were obtained from the Association of Religion Data Archives [67]. Data on urbanicity, defined as the percent of the population living in urban locales, were obtained from the Census Bureau [68]. We assessed the stability of this variable over time and found a high correlation ($r=0.85$) between the two years of data available (1990 and 2000), indicating that the 1990 value was sufficient. Because we used their 1990 values for all years in this analysis, percent fundamentalist and urbanicity were treated as fixed in all models. Data for percent black [69] and the percent Hispanic [69] and the percent of individuals in poverty [70] were obtained from the Census Bureau (poverty data for 1989 to 1991 were imputed).

Analysis plan

Our goal is to assess factors associated with changes in state's teen birth rates across the 18 years from 1990 to 2008. To examine these patterns, we combined Time-Varying Effects Models with random-intercept, multilevel models to assess time-varying and time-invariant (or fixed) relationships between the predictor variables and the teen birth rate, accounting for time-specific data nested within states. We term our final model a "hybrid" model because it includes both variables that vary over time in their association with teen birth rates and those that have a fixed, or constant, relationship over time with teen birth rates. Fixed effects resulting from the hybrid model reflect the relationship between each predictor and the dependent variable, net of state-level variation in the teen birth rate and net of time-varying effects.

Time-Varying Effects Models (TVEMs) are a sophisticated modeling technique recently developed to handle intensive

Longitudinal Data [71], which are characterized by many repeated measures over time within a relatively small number of subjects.¹ TVEM techniques allow for models to include both fixed and time-varying variables. These techniques provide a more accurate description of patterns over time that may not be identified by more common repeated measurement models that assume the relationships between covariates and dependent variables are fixed across time [72]. The only assumption of these models is a smooth function, meaning changes in the relationship between the independent and dependent variable over time are expected to be gradual rather than sudden. Like multilevel models, TVEM models account for variation between observations, in this case at the state-level.

We used SAS 9.3 to run our models. We used a publically available macro [73] to model changes over time with P-spline techniques. Splines are smoothing functions that estimate slopes using small sets of time parameters. Instead of modeling all 18 time points as a continuous function, splines allow us to break up these time points into smaller intervals. For our models, we specified six knots, meaning, if need be, the slope of the coefficient could change every three years.² To allow prediction of the teen birth rate, the data were lagged so that the teen birth rate in a given year³ was regressed on each predictor variable from the preceding year (e.g., state level data from 1989 were used to predict the 1990 teen birth rate and so on).

First, TVEM models were run for each predictor to assess whether changes in each measure had significant time-varying associations with the teen birth rate, not adjusting for covariates. We did not conduct this step for the three variables described above that we identified a priori as fixed (the percent of the population with a Bachelor's, the percent fundamentalist, and urbanicity) because we used the values from a single year for all 18 years in the analysis.

Building on these findings, we next tested a multivariate TVEM model to determine which variables continue to have a time-varying relationship with teen birth rates after controlling for the other variables in the model. We examined model fit statistics, such as negative log likelihood, Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC), to assess whether the time-varying model held greater explanatory power than the fixed effects only model (lower AIC and BIC values indicate better fitting models). The best-fitting model was iteratively determined as we included significant and excluded non-significant variables to produce the final multivariate model.

The final "hybrid" model distinguished between state policies/expenditures and state social and demographic variables that had an association with teen birth rates that changed significantly over the 1989-2007 period and those that did not, thereby avoiding the limitation of approaches that treat time-varying effects as fixed effects [72]. With the exception of key demographic control variables (percent in poverty, percent black, and percent Hispanic),⁴ variables with non-significant

¹ In our study, we analyze data from all 50 states, across 18 time points (1989-2007 for independent variables; 1990-2008 for the dependent variable). Thus, on balance, 900 observations are used for each variable, except for the three variables which were set at 1990 levels, due to large amounts of missing data.

² This smoothing is consistent with the smooth data assumption of TVEMs. Before deciding to use six knots, we specified models with up to 10 knots and fit statistics did not appreciably change (further verifying the smoothness of our data). For parsimony, we use six knots in our models.

³ To allow independent variables to predict teen birth rates nine months later, teen birth rates were lagged using the formula $tbr(t) = .25*tbr(t) + .75*tbr(t+1)$. For example, the teen birth rate for 1990 is the sum of the partial year birth rate in 1990 and partial year birth rate in 1991.

⁴ These variables were identified as key controls because their relationship to the teen birth rate has been well established by research.

fixed effects were dropped from the hybrid model to minimize degrees of freedom. Tests for multi-collinearity did not indicate that correlation among variables in the final model was a concern.

Results

Descriptive results

The mean teen birth rate across the 18-year time span was 47.3 births per thousand (SD = 14.4), although the mean for 1990 to 1999 was 52.4 births per thousand and the mean for the years 2000 to 2007 declined to 41.1 births per thousand. Over the entire time period, rates ranged from as low as 17.9 births per thousand in some states to 84.2 births per thousand in others. While all states experienced declines in teen birth rates over this time period, the rate of decline varied.

Final Model: Fixed and time-varying effects

Every variable was significantly associated with the teen birth rate in bivariate time-varying models; therefore, we tested each variable as time-varying in the iterative process described previously. The results of the final hybrid (which includes both variables that have a relationship with teen birth rates over time and those that have a constant, or fixed, relationship with teen birth rates over time) model can be seen in Table 1. Figure 1 shows the two time-varying coefficient functions graphically, which is the recommended mode of presentation to facilitate interpretation [71]. In these graphs, the slope coefficient function shows the expected change in the teen birth rate for a unit change in each independent variable, for each year from 1989-2007. After testing each variable as time-varying, we found that only two variables had a time-varying relationship with teen birth rates: the male-female ratio and the percent of the population who are Hispanic.

Reproductive and health policies and expenditures: As expected, higher public expenditures on family planning per woman aged 15 to

Variable	
Reproductive and Health Policy/Expenditures	
Public expenditures on family planning services per female 15-44 (2006\$)	-0.05**
Restrictive abortion laws	-0.31
Combined monthly max. AFDC/TANF and SNAP benefits (2006\$)	-0.01**
Percent of children age 6-17 uninsured	0.43**
Social, Economic, and Demographic Context	
Female labor force participation rate	-0.16*
Averaged freshman graduation rate	-0.15**
Percent of persons 25 and older with a Bachelor's degree	-0.85**
Current expenditures per pupil in average daily attendance (2006\$)	-0.001**
Violent crimes per 100,000 people	0.01**
Percent of population members of fundamentalist Christian church	0.07**
Proportion of births to unmarried females age 20-25	5.95
Male-female ratio	Time Varying: 78.42 to 92.03*
Percent of population black, non-Hispanic	0.35**
Percent of population Hispanic	Time Varying: 0.13 to 0.41*
Percent of individuals in poverty	0.33**
* p < 0.05; ** p < 0.01; Note: The unemployment rate and the percent of the population living in an urban area were not significant and were dropped from the final model	

Table 1: Results-State-level predictors of State Teen Birth Rates, using TVEM analysis.

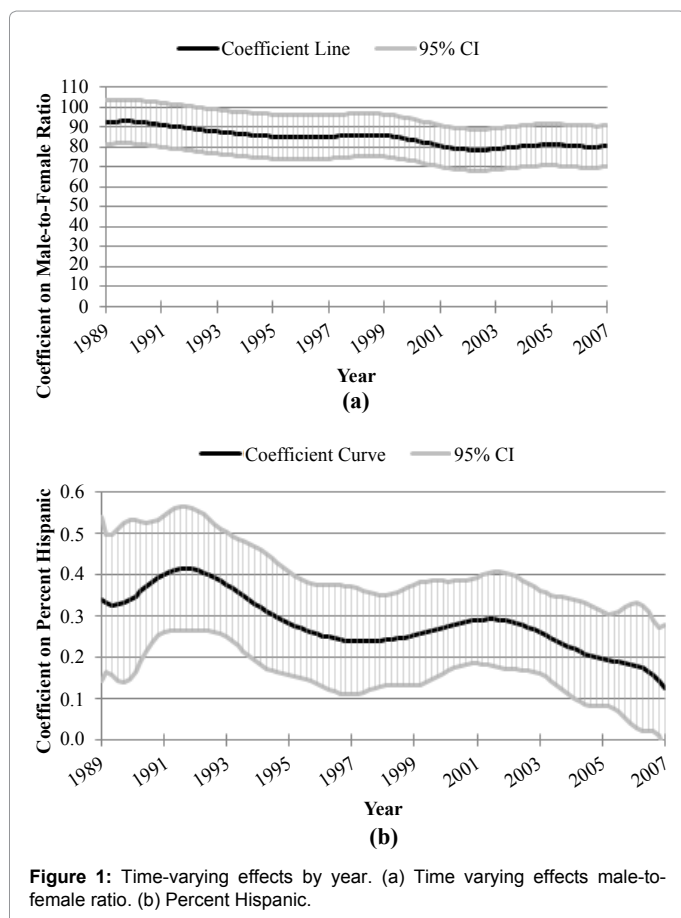


Figure 1: Time-varying effects by year. (a) Time varying effects male-to-female ratio. (b) Percent Hispanic.

44 were associated with a decrease in the teen birth rate ($\beta = -0.05$, $p < 0.01$), indicating that states that spent more on family planning had lower teen birth rates across all 18 years. Also, a lack of health insurance among children predicted higher teen birth rates ($\beta = 0.43$, $p < 0.01$), even when controlling for poverty levels.

Contrary to expectations, though, we found a significant negative relationship between the maximum monthly AFDC/TANF and SNAP benefits for a family of three and teen birth rates ($\beta = -0.01$, $p < 0.01$), such that higher maximum benefit levels were associated with lower teen birth rates across all 18 years.

Finally, we found no significant relationship between restrictive abortion laws and teen birth rates. Given the lack of reliable data on teen pregnancy and abortion rates over time for all states, we did not control for these measures in our analysis. However, we tested two additional models in which we included either the 1992 teen pregnancy rate or the 1992 teen abortion rate. When controlling for a fixed effect of teen pregnancy, we found that restrictive abortion laws have a positive relationship with teen birth rates, but that this is only a marginally significant association (results not shown). When controlling for a fixed effect of the teen abortion rate, we find that the coefficient on abortion laws becomes less negative, but remains non-significant (results not shown). Given these non-significant findings, no firm conclusions can be drawn about the nature of the relationship between abortion laws and birth rates from this analysis.

Social and economic measures of opportunity cost: As hypothesized, several variables indicating better educational and labor market opportunities in states were related to greater declines in rates

of teen childbearing in states. The female labor force participation rate ($\beta = -0.16$, $p = 0.02$) was negatively associated with teen birth rates. This means that a sixteen percent increase in the percent of females participating in the labor force in a state is associated with one less birth per 1,000 females ages 15 to 19, in a state. The unemployment rate, on the other hand, did not have a statistically significant association with teen birth rates and was dropped from the final model.

All three measures assessing educational opportunity in the states were, as hypothesized, related to state-level teen birth rates. Specifically, higher public expenditures per pupil was related to lower teen birth rates over time ($\beta = -0.001$, $p < 0.01$). Moreover, the averaged freshman graduation rate ($\beta = -0.15$, $p < 0.01$), and the percent of the population 25 years and older with a Bachelor's degree ($\beta = -0.85$, $p < 0.01$) were also negatively associated with teen birth rates, indicating that states with higher educational achievement have lower teen birth rates, consistently over this 18-year time span.

Other contextual factors: As hypothesized, higher violent crime rates ($\beta = 0.01$, $p < 0.01$) predicted higher teen birth rates, even when controlling for poverty levels. In addition, as expected, states with a greater percentage of the population who are affiliated with a fundamentalist church had higher teen birth rates ($\beta = 0.07$, $p < 0.01$).

Demographic factors: One of the few variables to have a time-varying relationship with teen birth rates was the male-to-female ratio (Figure 1a). Over the 18-year period between 1989 and 2007, this relationship generally became less strongly positive, with slight increases between 1997 and 1999 and between 2003 and 2005. A standard deviation increase in the ratio of males to females was associated with an increase of 2.76 births per thousand in 1989, 2.37 births per thousand in 2003, and 2.41 births per thousand in 2007. This finding suggests that an increasing availability of partners is associated with a higher teen birth rate.

Also as expected, both the percent of the state population who were black non-Hispanic ($\beta = 0.35$, $p < 0.01$) and the percent who were Hispanic were positively associated with the teen birth rate. The relationship between the birth rate and the percent Hispanic varied over time (Figure 1b): between 1989 and 1993, a larger Hispanic population predicted increasingly higher teen birth rates, but from 1993 to 2007, the relationship between a state's Hispanic population and teen birth rates weakened (with a small increase between 2000 and 2002). The percent of the population in poverty was significantly positively associated with teen birth rates ($\beta = 0.33$, $p < 0.01$). The non-marital birth ratio among 20- to 24-year-olds was not significantly associated with teen birth rates. Finally, urbanicity was not significantly associated with teen birth rates and was dropped from the final model.

Discussion

Implications

These analyses indicate that states with greater spending on family planning and education have lower teen birth rates. With regard to family planning, these analyses suggest that states that spent \$20 more per year, on average over time, on family planning per woman aged 15 to 44 had teen birth rates that were lower by one birth per 1,000 teens. Similarly, regarding education, our research suggests that states that spent \$1,000 more per pupil per year, on average over time, had teen birth rates that were lower by one birth per 1,000. Although our analysis does not assess the mechanism through which education spending might affect teen birth rates, our hypothesis was that when the opportunity cost to women of early childbearing is high, in part

because of improved educational opportunities due to increased state investment in education, teens will be more likely avoid early parenthood. An alternate explanation for this relationship between education spending and birth rates is that greater spending may allow states to decrease class sizes or focus more resources on students who are struggling and therefore at risk for dropout and early parenthood. The potential connection between education policy and teen childbearing at the state level warrants further attention from policymakers and researchers.

Our study finds no relationship between teen birth rates and laws that restrict abortion – specifically, the requirement of parental consent or notification for a minor's abortion and limitations on public funding for abortion. Adding controls for a state's abortion rate or pregnancy rate produced similar findings. It is possible that abortion policy has offsetting effects on the birth rate that cannot be explicated in these analyses. We found that states with higher monthly public assistance benefits have lower teen birth rates – a negative relationship that was consistent over time. One potential explanation for this relationship is that more generous public assistance packages, including food stamps, help low-income families to provide an environment for their children characterized by factors that mitigate chances of teen pregnancy, such as access to healthcare and greater economic stability. This may also reflect regional patterns whereby more generous benefits are found in regions with lower and declining birth rates. It is also possible that states in regions that tend to offer more generous benefits share characteristics or norms that are also related to lower teen birth rates, but that are unmeasured by this analysis. We found that a lack of health insurance among children predicted higher teen birth rates, even when controlling for poverty levels. This might indicate that health insurance increases access to health counseling and services related to contraceptives, which affect teen childbearing. This perspective is consistent with the finding that states with greater family planning expenditures tend to have lower teen birth rates.

It appears that measures of human capital that signal greater opportunity costs – indicated by a better educated population, more students graduating on time, and higher rates of female labor force participation – are associated with lower teen birth rates. We did not find any evidence that unemployment rates are associated with teen birth rates, net of other factors, perhaps because labor markets are more local than can be measured at the state level. We also found that one contextual factor associated with social disorganization, higher rates of violent crime, was related to higher teen birth rates but that another, non-marital childbearing among women in their early twenties, was unrelated to teen birth rates.

We found higher male-to-female ratios to be related to higher teen birth rates and that this relationship has fluctuated over time. While some past research suggests that when women have greater marital opportunities, they are more likely to delay childbearing [31], our results instead suggest a possible availability explanation, such that more males as potential partners is associated with higher fertility, although in this relationship was stronger in some years than in others.

Interestingly, only the male-female ratio and the percent of the population who are Hispanic have an association with teen birth rates that changed over time. Teen birth rates among Hispanics declined in the 1990s and early 2000s, so while we found that states with more Hispanics had higher teen birth rates, it became less of a factor over time, to the point of being almost not significant by the end of the time period.

Taken together, these findings indicate that states with higher opportunity costs of early childbearing – particularly those that invest in education and where female labor force participation is higher – had lower rates of early childbearing. Also critical is the provision of reproductive health services, to give adolescents the tools to avoid pregnancy and an opportunity to fulfill their educational and self-sufficiency goals.

Strengths and limitations

Limitations: This analysis has several limitations. First, there were missing data for multiple years for several variables, which is perhaps inevitable given the scope of this analysis. While it was possible to impute values for many of the missing observations, three variables had sufficient data missing to warrant treating them as fixed effects in all models using a single year of data for all years. Data for 1990 were available for all three and were used to represent circumstances in the initial year of the analysis. Second, we could not include rates of adolescent contraceptive use, sexual activity, or abortion, due to insufficient state-level data, although those data certainly would have strengthened our understanding of how state policies/expenditures relate to teen birth rates. Third, we chose to lag teen birth rates by three-quarters of a year for the adoption and dispersion of a policy. However, it is possible that this was not enough time or, more likely, that each policy has a different “lag” time in practice. Research using sensitivity tests may help address this methodological issue more effectively. Finally, it is possible that the level of our analysis resulted in null findings for some factors that may have a significant relationship with teen births at smaller levels of aggregation, such as within and between cities, neighborhoods, or individuals. While state-level analyses can be critiqued with ecological fallacy arguments, we note the importance of state authority and policies for children and youth and the need to inform state decision-makers [74].

Strengths: Reliance on individual-level data dominates research on teen births; however, many of the policies that affect teen childbearing are defined and funded at the state level. This study extends the body of knowledge by exploring how state-level teen birth rates are related to state policies and expenditures, as well as key policy-relevant contextual factors. For example, although some research suggests that increasing access to family planning services through publicly-funded insurance can reduce pregnancy rates at the individual level, this is among the few studies that make the connection between state-level expenditures for family planning services over time [15,17]. This is also one of few studies to examine how state education spending relates to teen childbearing. An understanding of these and other factors can inform state and federal policies to prevent teen pregnancy and reduce teen childbearing.

In addition, this study is one of the first studies to use a time-varying, multilevel modeling approach to adjust for time-varying and nested effects. Few studies have used data from all 50 states over nearly two decades to identify factors that influence teen birth rates. Even fewer studies have used methods to estimate fixed, random, and time-varying effects. By allowing effects to vary over time in our final model (rather than constraining them to be fixed effects as past models have done), we can identify more nuanced relationships that can better inform our understanding of how policies and other contextual factors shape teen birth rates over time.

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